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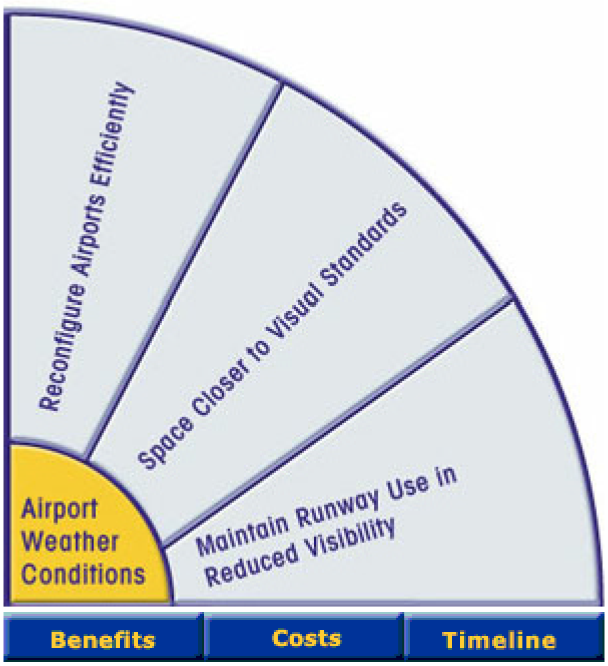
Objective: Keep Terminal Throughput Closer to Visual Levels in all Weather Conditions

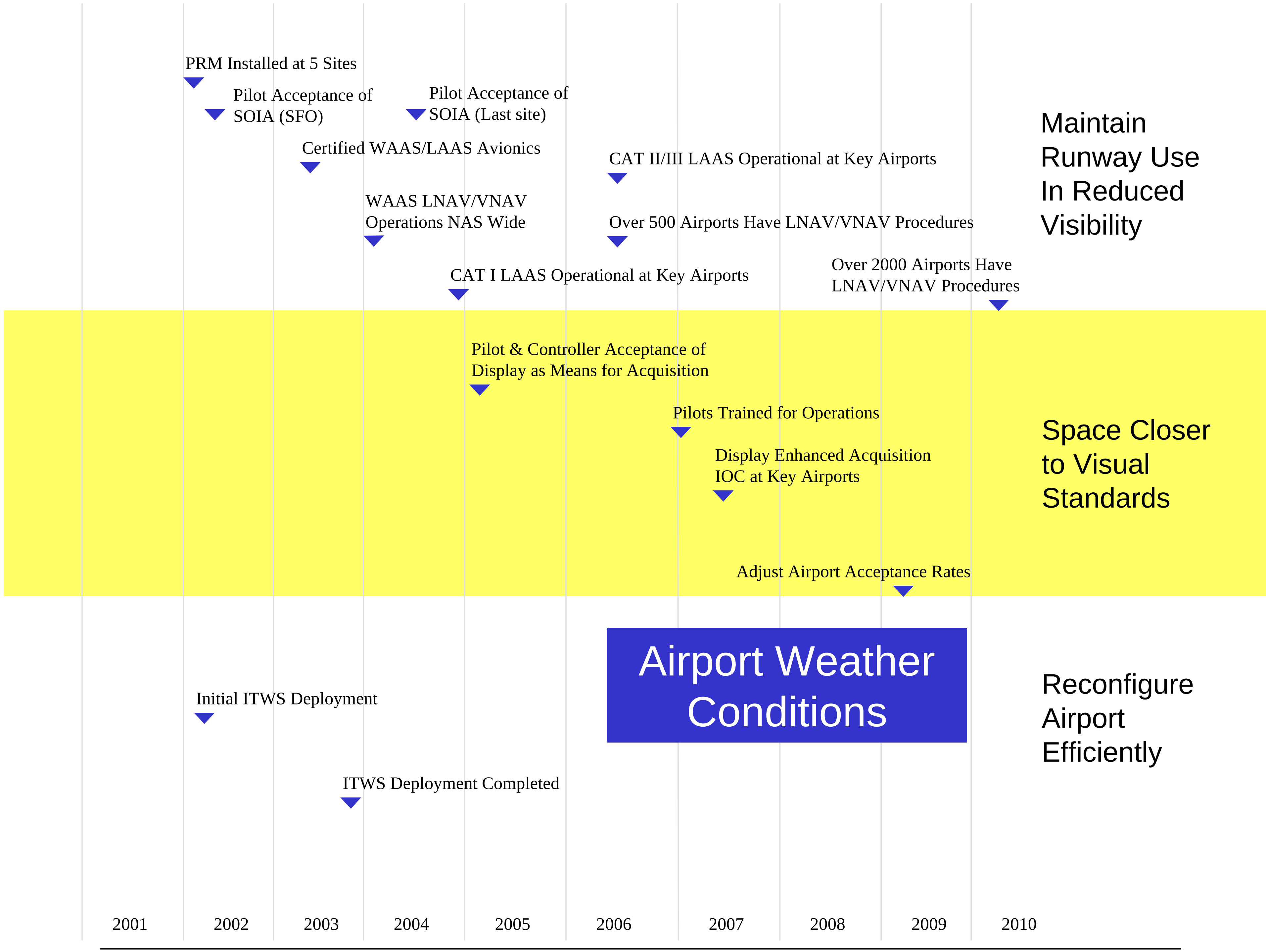
Related Links
Load Scenario Review Problem



A significant portion of the delay occurs when local weather reduces the throughput at an airport.

By keeping runways active and streamlining the process for reconfiguring an airport, we can close the gap between good weather and bad weather arrival and departure rates at about half the benchmarked airports. The result is, on average these airports are able to handle 10 extra flights per hour in poor weather.

Click on a "Wedge" to access the solution.


PRM Installed at 5 Sites
Pilot Acceptance of SOIA (SFO)
Pilot Acceptance of SOIA (Last site)
Certified WAAS/LAAS Avionics
CAT II/III LAAS Operational at Key Airports
WAAS LNAV/VNAV Operations NAS Wide
Over 500 Airports Have LNAV/VNAV Procedures
CAT I LAAS Operational at Key Airports
Over 2000 Airports Have LNAV/VNAV Procedures
Maintain Runway Use In Reduced Visibility
Pilot & Controller Acceptance of Display as Means for Acquisition
Pilots Trained for Operations
Display Enhanced Acquisition IOC at Key Airports
Space Closer to Visual Standards
Adjust Airport Acceptance Rates
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Reconfigure Airport Efficiently
2001
2002
2003
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2005
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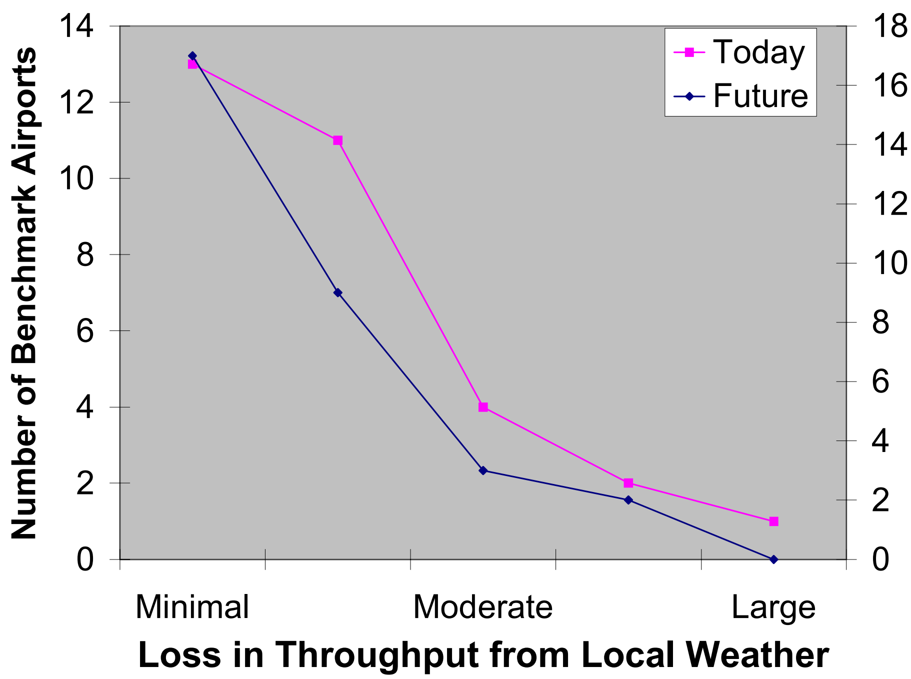
2010

Airport Weather Conditions - Benefits

Although the number of scheduled flights does not vary appreciably from day to day due to weather conditions, when an airport experiences bad weather, airport capacity decreases by over 50% in some cases. The OEP actions provide a relatively larger growth in capacity for these days (over good weather days), effectively shrinking the gap in throughput between airport optimal and reduced visibility conditions.



Note that some of the OEP actions drive airport capacity under good weather conditions beyond expected demand levels for 2010. This surplus capacity provides a margin to help accommodate the reductions in capacity due to poor weather conditions, mitigating the impact of weather conditions on the ability to meet demand.

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Solution: Maintain Runway Use in Reduced Visibility

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The reduction in arrival and departure rates as weather deteriorates is primarily due to loss of optimal runway configurations, either because of runway spacing or inadequate instrument approach capabilities. The solution is to apply technology and procedures to retain use of closely spaced runways and to increase the instrument approach capability. Instrument approach procedures will be published for runways that are capable of supporting them. By 2006 procedures will be completed for all scheduled air carrier airports.

Capability will continue to increase as satellite navigation services become universally available over the United States airspace with upgrades to support instrument approaches. Airport improvements in runways, markings, and airport lights are necessary to match this increasing capability for approaches in poor visibility.

Key Dates

PRM Installed at 5 Sites	2002
Pilot Acceptance of SOIA (SFO)	2002
Certified WAAS/LAAS Avionics	2003
WAAS LNAV/VNAV Operations NAS Wide	2004
Pilot Acceptance of SOIA (Last Site)	2004
CAT I LAAS Operational at Key Airports	2004
CAT II/III LAAS Operational at Key Airports	2006
Over 500 Airports have LNAV/VNAV Procedures	2006
Over 2000 Airports have LNAV/VNAV Procedures	2010

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Responsible Team: Maintain Runway Use in Reduced Visibility

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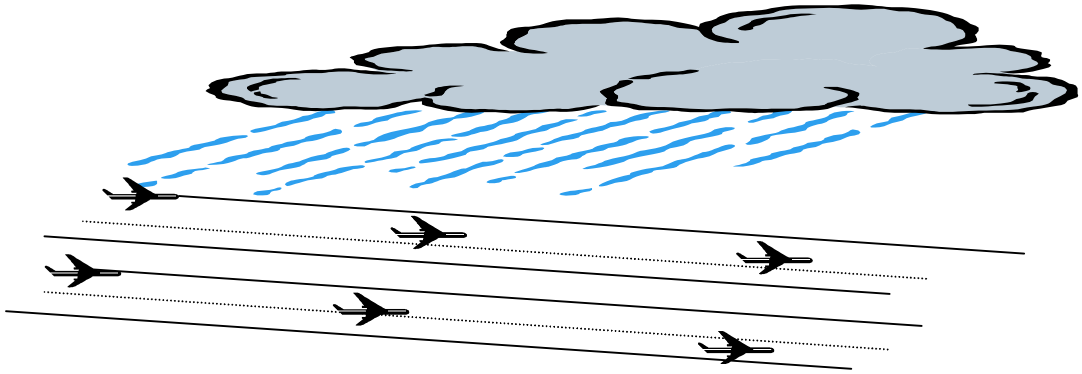
Please send your comments to nas-evol@mitre.org

This page was last updated on May 30, 2001

AW-1: Maintain Runway Use in Reduced Visibility

Continue arrival and departure operations as weather deteriorates from VMC to IMC by increasing instrument approach services.



Background

Aircraft arrival and departure rates generally decrease at airports as weather deteriorates from Visual Meteorological Conditions (VMC) to Instrument Meteorological Conditions (IMC). This reduced capacity is primarily due to the inability to continue operations because of a lack of instrument approach services or aircraft capability to use those services. Other capacity limiting operational restrictions, such as increased en-trail approach standards and closely spaced parallel runway operations are addressed in AW-2.

Ops Change Description

Instrument approach capability will continue to increase in the mid-term, providing access to runways in IMC beyond what is available today. Existing approach services will be sustained over the next ten years, except at a limited number of navaid facilities where usage does not support continued operation. New precision approach services will be provided to support the increasing demand for these services. Airport improvements in runways markings, airport lights, and surveillance systems will be increased to support this precision approach capability.

Instrument approach procedures will be published for most runway ends capable of supporting them. Procedures for Part 139 (scheduled air carrier) airports will be completed by 2006. Procedures for public airports with runways over 5000 feet will be completed by 2010. Capability will continually increase as Lateral Navigation/Vertical Navigation (LNAV/VNAV) approach services become universally available over the US airspace in the mid-term and will be upgraded to be capable of Category I operations in the long-term using Local Area Augmentation System (LAAS) and then Wide Area Augmentation System (WAAS). FAA is currently working on new area navigation (RNAV) based required navigation performance (RNP) approach procedures. The following RNAV procedures with vertical guidance, are scheduled to be published on July 12, 2001:

- LBO Rwy 18, CBK Rwy 35, M06 Rwy 34, GR3 Rwy 18 and Rwy 24, and JYG Rwy 15 *(runway ends with no previous Standard Instrument Approach Procedure established prior to the RNAV procedure).*
- LBO Rwy 36, M06 Rwy 16, ILM Rwy 17, BDE Rwy 12, MBS Rwy 14 and Rwy 32, and JYG Rwy 33 *(runway ends with previous non-precision approaches established prior to the RNAV procedure).*

These approach procedures will increase in both availability and usage as widespread equipage and operations are enabled by the new navigation services. Increased usage of RNAV/RNP procedures will increase capacity at airspace constrained airports.

Definition and Requirements for Instrument Approach Services

Due to the complexity of the terms used in this paper, a set of definitions that provide a foundation for the discussion of the detailed operational changes are presented below.

- *Non-precision approach (NPA)* – Non-precision approach services support approach operations between 3 miles and 1 mile of visibility. LNAV criteria define non-precision approach procedures. Current criteria for LNAV is very similar to that for Localizer approaches (part of ILS), except the source for the signal is, of course, not a localizer but rather a course developed between waypoints. Display within the cockpit varies by manufacturer of the airborne equipment, but generally can be thought of as similar to the localizer displays; i.e., with variance from course centerline displayed on the cockpit instrument as simple displacement of the indicator needle from its centerpoint.
- *Precision approach (PA)* – Below 1 mile visibility, increasing levels of precision approach operations require increasing levels of airport runway capability, airport runway lights, approach lights, runway visual range, and precision approach services.
- *Category I* – Category I operations support stabilized approach to as low as a 200' decision height, depending on obstacles and runway capability. An airport capable of supporting scheduled air carrier service (Part 139) requires appropriate runway construction, markings, and signage to support PA operations.
- *Category II* – Category II operations support stabilized approaches to as low as 100' decision height. A more accurate, higher continuity PA signal, high approach lights (ALSF-2) and rollout RVR sensor enable Category II operations.
- *Category III* – Category III operations support stabilized approach, landing, and rollout operations to as low as no decision height. A more accurate, higher continuity signal and mid-point RVR sensor enable Category III operations.

Benefits, Performance and Metrics

- Throughput in arrivals per hour are sustained at a higher level as the ceiling and visibility decrease.
- Increase in arrivals per hour as weather conditions deteriorate to IMC.

Scope and Applicability

Near-Term:

- Currently, there are 61 new LNAV runways/airports (straight in approaches available for the first time) in FY01, with a total of 1144 runways with new LNAV approaches to date. For LNAV/VNAV approaches, there are 65 new in FY01, with a total of 108 to be accomplished in FY01. These approaches are not intended as replacement for Instrument Landing System (ILS) approaches. It is only with LAAS and then WAAS deployment that the evolution to CAT I through CAT III operations becomes a reality. These approaches do provide access to runways/airports that currently do not have any precision approach capabilities (no ILS possible), and improve safety. In most cases, these LNAV/VNAV approaches actually decrease Minimum Decision Altitude (MDA) from current operations (e.g., PNS Rwy 8 and Rwy 35). The most recent new LNAV/VNAV procedures that were published on May 17, 2001 for runways that had no previous Standard Instrument Approach Procedure (SIAP) are:

  - Rantoul (2I5), Runway 9, 18, and 36
  - Atkinson Municipal (PTS), Runway 21 and 34
  - Pensacola (PNS), Runway 26
  - Lee County – Brick Field (TTA), Runway 21
  - Flora Municipal (FOA), Runway 3

- *New RNAV instrument approach procedures.* The total number of instrument approach procedures in the NAS has doubled since 1994 to about 12,600. 3,009 GPS NPA procedures have been developed and over 2,427 have been published. All new RNAV instrument approach procedures are being developed with lateral and vertical guidance, unless the approach cannot accommodate the procedure. Approaches for the 576 airports serving Part 139 operations are in development and will be completed by 2006.
- *New precision approach services.* Precision approach capability will be established, improved, or sustained at several runways with ILSs, approach lighting systems, runway visual range, and Precision Approach Path Indicator (PAPI). None of the FAA qualifiers for new ILSs will be established in the near term. Of the 15 facility mandates in 1999, 10 in 2000, and 28 in 2001, 14 of 53 will be commissioned in the near term. Critical requirements for two ALSF-2 and four MALSR replacement projects are identified as near-term critical funding needs to avoid loss of approach services in the near term. The requirements to sustain ground based navigational aids will be approved in the near term. Previously identified safety needs for PAPI and distance measuring equipment will be analyzed in the near term.
- National SOIA standards will be developed with the user community.

Mid-Term:

- A number of ILSs and associated ancillary aids will be installed at select runways to provide new precision approach capability. The remaining 39 congressional mandate locations will be satisfied.

- WAAS will provide approach services supporting LNAV/VNAV approaches NAS-wide at locations where only non-precision approaches exist today. Most of the approaches at the Part 139 airports will be completed in the mid-term, with the balance completed by 2006.
- LAAS will provide precision approach services authorized to support Category I operations.
- Beyond the initial five sites for the Precision Runway Monitor (PRM) System, up to two other sites will receive this system to support closely spaced runway operations in IMC and Simultaneous Offset Instrument Approaches (SOIA) in deteriorating VMC.
- RNAV Instrument Approach Procedures: 780 public airports with runways over 5000 feet long will be completed by 2010.
- Expect further site specific SOIA procedure development as new PRM sites are approved and will be used.

Long-Term:

- WAAS service planned for upgrade to Category I capability. A WAAS upgrade decision will be made by 2002. A decision on how far to reduce the existing ground-based infrastructure will be made in 2006. LAAS Category I approach procedures will start becoming available in 2003. Of the 160 airports planned for LAAS services, 104 airports will be upgraded in the long-term to provide services supporting Category II/III operations, and the remaining 56 will continue to support Category I procedures.
- Although approximately 1100 NAS runway ends are equipped to support PA service, many of the approximately 3000 NPA runway ends in the NAS will require airport infrastructure upgrades to support PA services. Visibility minimums of 1 mile can be supported with visual runway markings and low intensity runway lights (LIRL) for nighttime operations. Medium intensity runway lights (MIRL) and precision or non-precision runway markings are required to reduce visibility minima to 3/4 mile. To establish 1/2 mile-visibility minimums the additional equipment requirements are precision runway markings, MIRLs for nighttime operations, and an approved approach lighting system.
- The LAAS services will be extended at major airports with eligible runways to Category II/III precision starting in 2006.
- For most paved public airports, GPS precision approaches augmented by WAAS will support visibility of one mile without requiring significant airport improvements in marking, lighting, and signage, but only Part 139 and public airports with 5000’ runways will have instrument approach procedures by 2010. Procedures for the remaining 1,300 public airports with paved runways will be accommodated after 2010.

Key Decisions

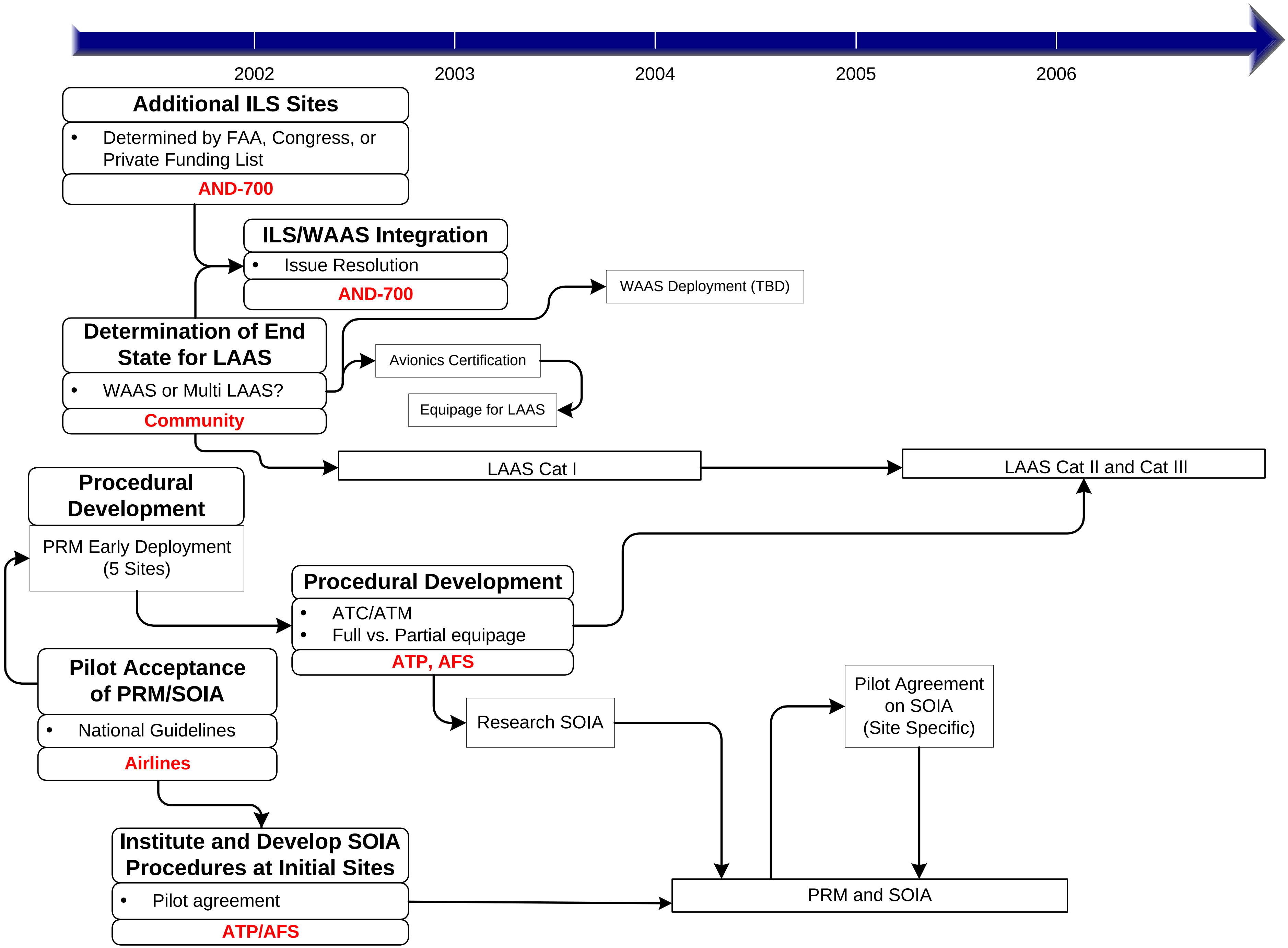
- FAA and users will determine end-state services for WAAS and LAAS systems (technical feasibility and economic issues) before deployment, aircraft equipage, and ILS decommissioning begins. Key decision points are 2002 on WAAS upgrade path, and 2006 on ILS decommissioning path.
- Definition of WAAS and LAAS concepts and procedures.
- Complete Advisory Circulars 120-29A, 20-RNP and 90-RNP.
- Approval of Global Navigation Satellite System (GNSS) Standards and Recommended Practices by ICAO states.
- Approvals for PRM/SOIA procedures.
- Development and training of ATC procedures.

Key Risks

- Funding to develop, procure, install, and commission the above planned services.
- Geo-stationary satellite leases/acquisition risk for WAAS services.
- Timing and availability of WAAS/LAAS services.
- Voluntary user equipage and usage of WAAS/LAAS avionics/capability.
- Environmental and airport infrastructure constraints.
- Schedule for production version of WAAS/LAAS receiver.
- Planning for markings, signage, and lighting for precision approach runways.
- Pilot acceptance for SOIA procedures.

V3.0 (30 May 2001)

AW-1: Maintain Runway Use in Reduced Visibili



Solution: Space Closer to Visual Standards

Procedures for visual approaches require that the pilot visually acquire nearby aircraft as well as the runway. In marginal visibility conditions, pilots may have difficulty visually acquiring the runway or nearby aircraft, reducing arrival rates. Cockpit tools and displays can help to achieve higher throughput by enabling more rapid identification of aircraft, reducing the need for additional communications between the pilot and controller to advise on traffic. The cockpit display indicates target aircraft and trajectory information which the pilot can correlate to what is visible, providing faster target identification and helping the pilot maintain visual separation.

Key Dates

▶ Pilot & controller acceptance of display as means for acquisition	2005
▶ Pilots trained for operations	2007
▶ Display enhanced acquisition IOC at key airports	2007
▶ Adjust Airport Acceptance Rates	2009

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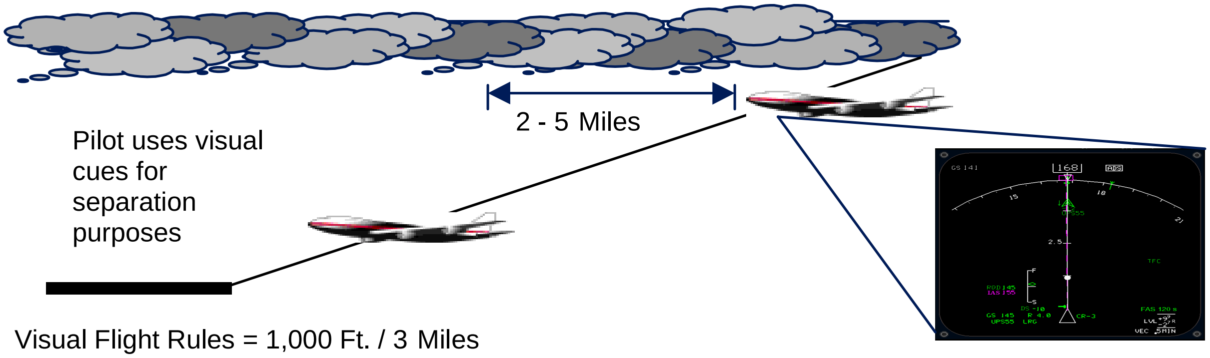
AW-2: Space Closer to Visual Standards

Using cockpit tools and displays to achieve VMC throughput capacity in all weather conditions.



Background

Most airports have established weather minima below which visual approaches cannot be conducted, primarily due to the difficulty for the pilot to visually acquire the runway or traffic in such weather. Currently, the requirement for visual approaches is ceiling 500 feet above minimum vectoring altitude and visibility 3 miles.. However, other environmental conditions such as haze, sunlight, smoke, and patchy clouds may effectively prohibit visual approaches at higher ceiling and visibility values. Without a cockpit tool that provides situational awareness of the leading aircraft, it is difficult for the pilot to acquire and maintain visual acquisition of the leading aircraft in marginal VMC.

Ops Change Description

The primary objective of this operational change is to help the pilot, through the use of the Cockpit Display of Traffic Information (CDTI), visually acquire and identify an aircraft that has been referenced as traffic by ATC, so the controller may clear the aircraft for a visual approach. The CDTI will enable quicker identification since the pilot will be able to correlate the target aircraft and trajectory information from the CDTI to the actual traffic as seen out-the-window. With quicker identification of pertinent traffic, the need for additional traffic advisories or follow-on interactions between the pilot and controller should be reduced. Another objective is to better enable the pilot to obtain and maintain visual separation once it is initially established.

The primary advantage of this application is that the pilot of an Automatic Dependent Surveillance – Broadcast (ADS-B)/CDTI aircraft will be better able to isolate the traffic to be acquired on the CDTI when the other aircraft is also ADS-B equipped. This advantage is made possible by features on the CDTI which display the call sign of other aircraft. This should permit even shorter visual acquisition times and greater pilot and controller confidence that the pilot has identified the correct aircraft. Consequently, this should result in lower pilot and controller workload and reduced communication burden. In addition, it is anticipated that this will result in the ability to continue visual approaches into marginal VMC. For example, as mentioned earlier, the ceiling requirement for visual approaches is 500 feet above minimum vectoring altitude and visibility 3 miles. With CDTI, the 500 feet criteria could be lowered. Also, since visual acquisition will be enhanced, visual conditions will be able to be maintained in marginal conditions for a longer period of time.[1]

Additional operational applications will be explored for the use of “Along Track Separation” to maintain closer spacing during the approach phase to parallel runways separated by less than 2500 feet. Potential reduction in dependent runway distances will be assessed using data from ongoing wake vortex research. Also, research addressing human factors, roles and responsibilities, and certification issues for the proposed longer-term spacing applications in IMC will be conducted during the OEP time frame.

Benefits, Performance and Metrics

- Increase airport percent effectiveness on the order of 1 to 5 percent for arrival throughput in VMC.
- Increase airport percent effectiveness for arrival throughput in deteriorating VMC.
- Reduction in en route delay resulting from better flows into airports.

Scope and Applicability

- Benefits for the enhanced visual acquisition/situation awareness are dependent upon the degree to which visual acquisition is extended into marginal VMC. This will vary from airport to airport.
- Along Track Separation applications will be assessed by 2004.
- Potential procedural changes based on ongoing wake vortex data collection and analysis will be examined by 2003.

Key Decisions

- Equipage to a level that will provide benefits based on these and other committed applications.
- ADS-B data link (i.e., Mode S, Universal Access Transceiver, and/or VDL-4) decision will impact cost, interoperability, and community participation.
- Safety assessment of potential parallel runway dependency changes based on wake vortex data.

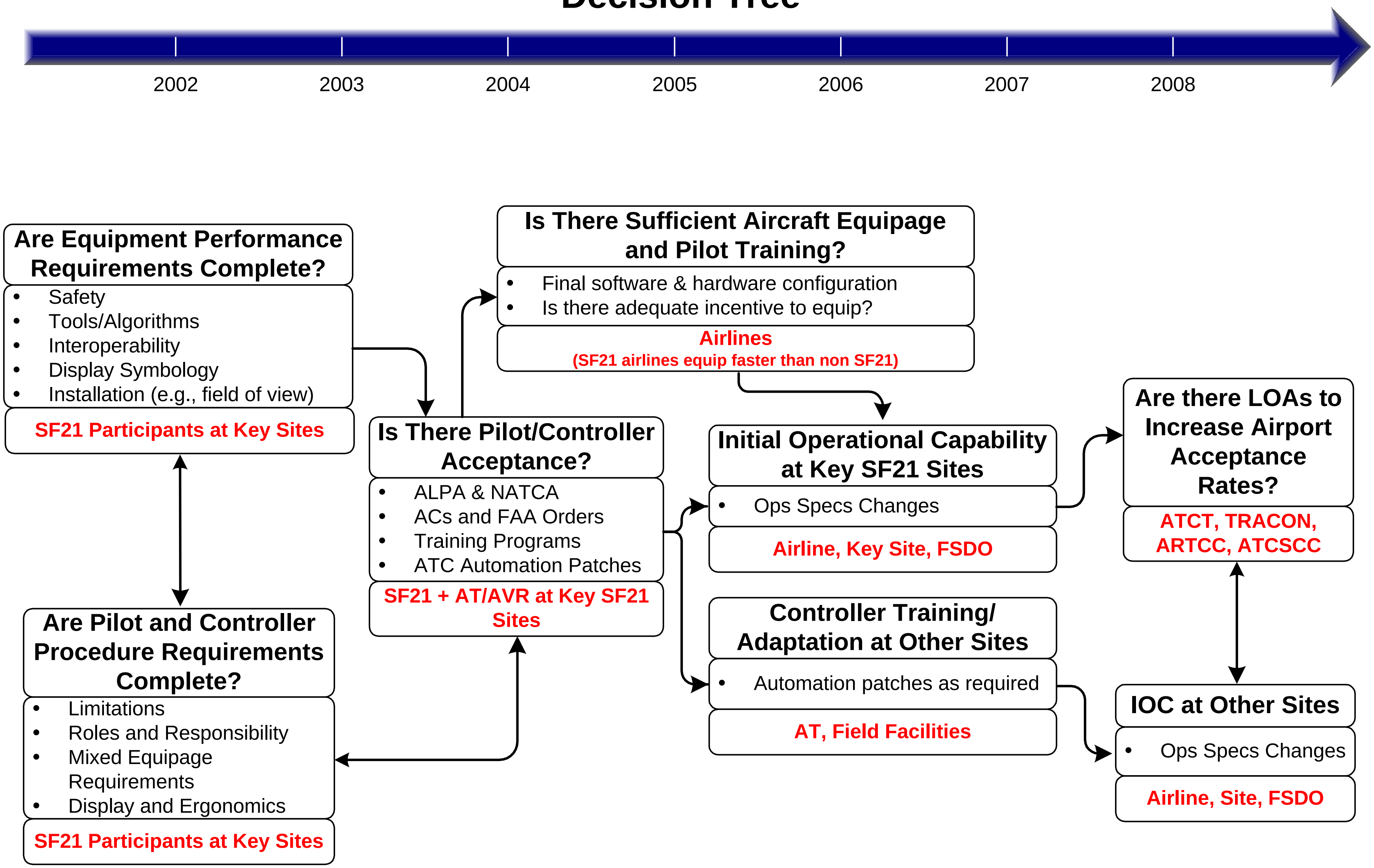
Key Risks

- Pilot acceptance of new application of visual acquisition enhancements.
- Controller acceptance of new phraseology required for visual acquisition enhancements.

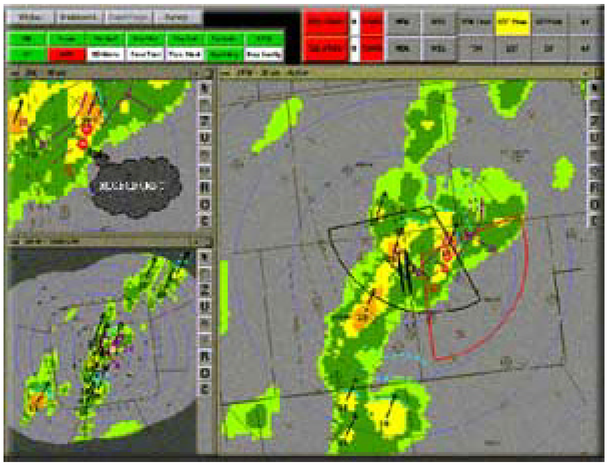
[1] Although we use ADS-B in the description, we do recognize that position information may come from multiple sources/mechanisms.

V3.0 (30 May 2001)

AW-2: Space Closer to Visual Standards Decision Tree



Solution: Reconfigure Airports Efficiently



Changes in wind direction over airport runways, and the onset or end of hazardous weather in the vicinity of the airport often require changes to airport arrival and departure configurations. Weather changes can result in a significant disruption of traffic flow if required configuration changes are not known in advance. With improved airport weather observations and predictions, traffic flow configurations can be proactively planned and coordinated between personnel at all of the involved air traffic control and airline operations facilities. The result will be smoother reconfigurations, optimization of traffic flow and reduced congestion at the airport. Prototypes are currently being used for this purpose at six airports. By the end of 2003 the enhanced reconfiguration capabilities will be available at 34 sites covering 47 airports.

Key Dates

▶ Initial ITWS Deployment	2002
▶ ITWS Deployment Completed	2003

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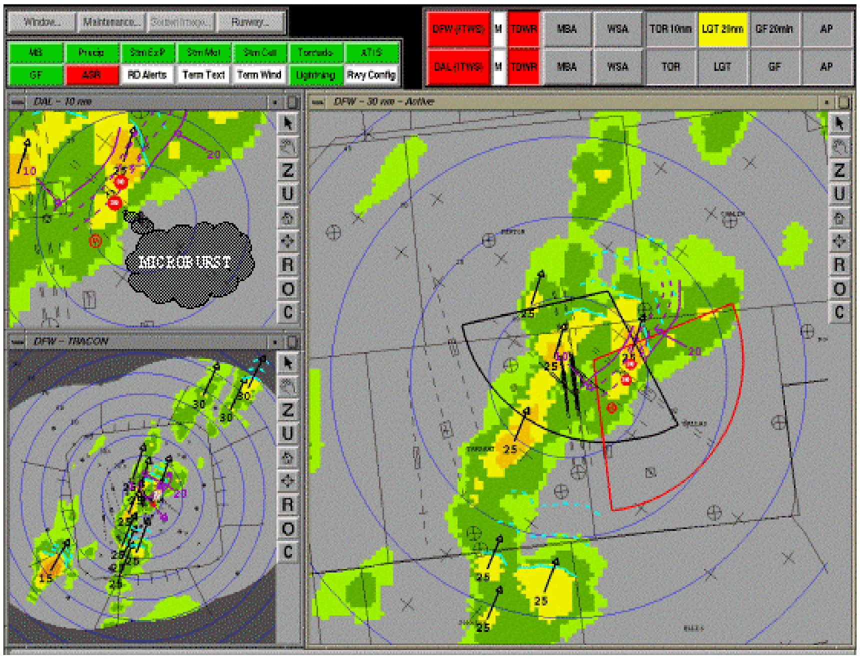
AW-3: Reconfigure Airports Efficiently

Timely planning and coordination of configuration changes during changing weather conditions.



Background

Significant changes in wind direction over airport runways, or the onset/end of hazardous weather in the airport environment, often require changes to the airport departure and arrival configurations. Weather changes can result in a significant disruption of traffic flow if knowledge of the required changes are not known in advance. With this understanding, the FAA is deploying systems that will assist users to make better informed decisions to minimize disruption to traffic flow while maintaining safety integrity of the system.

Operational Change Description

Advance knowledge is acquired through improved weather observations in the 3-d airport terminal environment out to 60 miles from the airport, and through improved weather prediction tools. Traffic flow reconfiguration can be proactively planned and coordinated between traffic flow management personnel in the TRACON, ARTCC and ATCSCC, and dispatchers in AOCs with improved weather observations and predictions. The result will be a much smoother reconfiguration, optimization of traffic flow and less congestion at the airport. There are two areas of operational impact addressed below:

- <u>AW-3.1:</u> Improved configuration coordination with facilities and carriers.
- <u>AW-3.2:</u> Improved procedures for adjacent airport coordination.

Benefit, Performance and Metrics

- Optimize the traffic flow patterns of aircraft inbound to the airport and outbound from airport. 28,000 hours delay savings at JFK alone since 1998 with pre-production prototype ITWS.
- For inbound aircraft, reduce upstream holding patterns and departure airport holds.
- Reduce ground control congestion caused by having to redirect departing aircraft to the opposite end of the runway. Expect 7- to 15-minute improvement in reestablishing runway flows after severe weather runway changes.
- Reduce gate holds and stops freeing gates for inbound aircraft.
- Significant safety benefits resulting from the integration of weather information and wind shear alerting.

AW-3.1 Configuration Coordination with Facilities and Carriers

Scope and Applicability

Currently, Newark, LaGuardia, JFK, Dallas-Fort Worth, Memphis and Orlando are using pre-production prototype ITWS systems for facility and carrier configuration coordination. Additional systems will be installed at Kansas City and Houston airports in a limited deployment acquisition this year. The remainder of the deployment schedule for full production and pre-planned product improvements is in the ITWS Program Plan. By December 2003 it is planned to have fielded 34 Product Generator ITWS Sites for 47 airports. Initial deployment of ITWS will assimilate the information from weather systems (windshear, weather radar and surface observations) in the airport terminal environment. It will provide terminal, tower, and en route TMU controllers with information on microburst prediction and thunderstorm attributes such as storm motion, precipitation type, gust fronts and surface wind patterns, many of which affect the airport configuration. External users (i.e., airline operations centers) also will have access to ITWS products. Future enhancements under pre-planned product improvement include the terminal convective weather forecast algorithm, in-flight icing product and an interface to the controller's automation system (STARS).

- Applies to high traffic (pacing) airports, particularly those airports in regions where thunderstorms frequently occur.
- Applies to the TRACON at these pacing airports, the ARTCC containing these pacing airports and ATCSCC for traffic flow management across the whole NAS.
- Applies to industry groups such as Airline Operations Centers (AOCs).

- Applies to sensor systems covering the airport terminal environment from which ITWS obtains its weather information.
- Applies to NOAA/NCEP from which ITWS obtains its gridded weather prediction data.

Key Decisions

- What level of real time collaboration is necessary between TFM and AOCs?
- Need for new procedures and training for AOCs.

Key Risks

- Commitment to adopting new procedures and necessary training for AOCs.
- Development of local procedures for coordinating the reconfiguration and traffic flow.

AW-3.2 Procedures for Adjacent Airport Coordination

Scope and Applicability

ITWS operations at New York airports (EWR, LGA and JFK) are addressing adjacent airport coordination. A number of other 34 ITWS production sites will also include multiple airport environments.

- Determine the dependencies of multiple airports on arrival and departure routes and procedures. Apply these to other multiple airport environments.
- Develop and field test strategies for use of alternate airport configurations, routes and procedures that will be necessary in specific weather situations.
- Develop efficient communication pathways for the distribution of ITWS information between the TRACON, ARTCC, ATCSCC and AOCs.
- Promote among decision makers common situational awareness of weather scenarios affecting traffic routes and potential reconfigurations.

Key Decisions

- None identified.

Key Risks

- Develop playbook set of airport configurations (multiple airports) and associated arrival/departure procedures and routes.
- Establish the planning and implementation process for changes that come about as a consequence of the playbook exercises.
- Provision of new capabilities requires procedural changes.

AW-3: Reconfigure Airports Efficiently Decision Tree